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Growth and optical characteristics of InAs quantum dot structures with tunnel injection quantum wells for 1.55 μm high-speed lasers

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Abstract

InP based lattice matched tunnel injection structures consisting of a InGaAs quantum well, InAlGaAs barrier and InAs quantum dots designed to emit at 1.55 μm were grown by molecular beam epitaxy and investigated by photoluminescence spectroscopy and atomic force microscopy. The strong influence of quantum well and barrier thicknesses on the samples emission properties at low and room temperatures was investigated. The phenomenon of a decreased photoluminescence linewidth of tunnel injection structures compared to a reference InAs quantum dots sample could be explained by the selection of the emitting dots through the tunneling process. Morphological investigations have not revealed any effect of the injector well on the dot formation and their size distribution. The optimum TI structure design could be defined.

Keywords:
Atomic force microscopy, Molecular beam epitaxy, Nanostructures, Semiconducting indium compounds, Quantum dots, Quantum wells

1. Introduction

The growth and application of zero dimensional quantum dots (QDs) in a variety of devices has been investigated for many years. Semiconductor lasers with QDs as active material have shown many advantages, for instance temperature stability [1–4], low threshold current density [5, 6] and wide spectral

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